Ref. T1/3.02

**SIDE SHELL DOORS AND STERN DOORS ON RO-RO PASSENGER SHIPS**

1 The Maritime Safety Committee, at its sixty-sixth session (28 May to 6 June 1996), noted that the Assembly, at its nineteenth session, adopted resolution A.793(19) entitled "Strength and securing and locking arrangements of shell doors on ro-ro passenger ships". In doing so, the Assembly noted that IACS had issued Unified Requirement (UR) S8 for bow doors to be applied to new ro-ro passenger ships and, retrospectively, to existing ro-ro passenger ships by Unified Requirement S16, and urged Governments to ensure that all ro-ro passengers ships comply with IACS UR S8 for bow doors and with Unified Requirements applicable to all other shell doors, as they may be accepted by the Maritime Safety Committee. The Assembly therefore urged IACS to review similar Unified Requirements for all other shell doors leading on to the car deck for application to all ro-ro passenger ships and to submit the result of that review to MSC 66.

2 The Committee, having considered IACS UR S9 on Side shell doors and stern doors and UR S15 on Side shell doors and stern doors - Retrospective application of UR S9, as amended in 1996, to existing ro-ro passenger ships, submitted by IACS in response to the aforementioned request of the Assembly, agreed to circulate these IACS Unified Requirements to Member Governments. The Committee noted that IACS would apply UR S9 to new ships from 1 July 1997 and UR S15 to ro-ro passenger ships constructed before 1 July 1997 not later than the date of the first periodical survey after 1 July 1997.

3 Member Governments are invited to bring the annexed IACS Unified Requirements to the attention of all concerned and, as urged by the Assembly at its nineteenth session, ensure that all ro-ro passenger ships comply with these IACS Unified Requirements.

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ANNEX

IACS UNIFIED REQUIREMENTS S9 AND S15



# S9 (1984) (Rev. 1 1990) (Rev. 2 1993) (Rev. 3 1996) (Rev. 4 1996) Side Shell Doors and Stern Doors

## S9.1 General

S9.1.1 *Application*

S9.1.1a These rules give requirements for the arrangement, strength and securing of side shell doors, abaft the collision bulkhead, and stern doors leading into enclosed spaces.

S9.1.2 *Arrangement*

S9.1.2a Stern doors for passenger vessels are to be situated above the freeboard deck. Stern doors for Ro-Ro cargo ships and side shell doors may be either below or above the freeboard deck.

S9.1.2b Side shell doors and stern doors are to be so fitted as to ensure tightness and structural integrity commensurate with their location and the surrounding structure.

S9.1.2c Where the sill of any side shell door is below the uppermost load line, the arrangement is to be specially considered (see IACS Interpretation LL 21).

S9.1.2d Doors should preferably open outwards.

S9.1.3 *Definitions*

Securing device - a device used to keep the door closed by preventing it from rotating about its hinges or about pivotted attachments to the ship.

Supporting device - a device used to transmit external or internal loads from the door to a securing device and from the securing device to the ship's structure, or a device other than a securing device, such as a hinge, stopper or other fixed device, that transmits loads from the door to the ship's structure.

Locking device - a device that locks a securing device in the closed position.

## S9.2 Strength Criteria

S9.2.1 *Primary structure and Securing and Supporting devices*

S9.2.1a Scantlings of the primary members, securing and supporting devices of side shell doors and stern doors are to be determined to withstand the design loads defined in S9.3, using the following permissible stresses :

shear stress : $\tau = \frac{80}{k}$ N/mm$^2$

bending stress : $\sigma = \frac{120}{k}$ N/mm$^2$

equivalent stress : $\sigma_e = \sqrt{\sigma^2 + 3\tau^2} = \frac{150}{k}$ N/mm$^2$

where k is the material factor as given in S4, but is not to be taken less than 0.72 unless a direct strength analysis with regard to relevant modes of failures is carried out.

Note: Revision 4 of the UR is applicable to new ships for which the request for classification is received on or after 1 July 1997. ▶

**S9** cont'd

S9.2.1b The buckling strength of primary members is to be verified as being adequate.

S9.2.1c For steel to steel bearings in securing and supporting devices, the nominal bearing pressure calculated by dividing the design force by the projected bearing area is not to exceed $0.8\ \sigma_F$, where $\sigma_F$ is the yield stress of the bearing material. For other bearing materials, the permissible bearing pressure is to be determined according to the manufacturer's specification.

S9.2.1d The arrangement of securing and supporting devices is to be such that threaded bolts do not carry support forces. The maximum tension in way of threads of bolts not carrying support forces is not to exceed $125/k$ N/mm$^2$, with k defined in S9.2.1a.

### S9.3 Design loads

S9.3.1 The design forces, in kN, considered for the scantlings of primary members, securing and supporting devices of side shell doors and stern doors are to be not less than :

(i) Design forces for securing or supporting devices of doors opening inwards :

- external force : $F_e = A\ p_e + F_p$
- internal force : $F_i = F_o + 10\ W$

(ii) Design forces for securing or supporting devices of doors opening outwards :

- external force : $F_e = A\ p_e$
- internal force : $F_i = F_o + 10\ W + F_p$

(iii) Design forces for primary members :

- external force : $F_e = A\ p_e$
- internal force : $F_i = F_o + 10\ W$

whichever is the greater,

where :

A — area, in m$^2$, of the door opening,

W — mass of the door, in t,

$F_p$ — total packing force in kN. Packing line pressure is normally not to be taken less than 5N/mm,

$F_o$ — the greater of $F_c$ and 5 A (kN),

$F_c$ — accidental force, in kN, due to loose of cargo etc., to be uniformly distributed over the area A and not to be taken less than 300kN. For small doors such as bunker doors and pilot doors, the value of $F_c$ may be appropriately reduced. However, the value of $F_c$ may be taken as zero, provided an additional structure such as an inner ramp is fitted, which is capable of protecting the door from accidental forces due to loose cargoes.

$p_e$ — external design pressure, in kN/m$^2$, determined at the centre of gravity of the door opening and not taken less than :

$10\,(T - Z_G) + 25$ for $Z_G < T$

$25$ for $Z_G \geq T$

Moreover, for stern doors of ships fitted with bow doors, pe is not to be taken less than :

$$P_e = 0.6\lambda C_H (0.8 + 0.6L^{0.5})^2$$

$\lambda$ — coefficient depending on the area where the ship is intended to be operated:

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**S9** cont'd

$\lambda$ = 1 for sea going ships,

$\lambda$ = 0.8 for ships operated in coastal waters,

$\lambda$ = 0.5 for ships operated in sheltered waters.

*Note : Coastal waters and sheltered waters are defined according to the practice of each Classification Society. As an example, coastal waters may be defined as areas where significant wave heights do not exceed 4m for more than three hours a year and sheltered waters as areas where significant wave heights do not exceed 2m for more than three hours a year.*

CH = 0.0125 L for L < 80m
= 1 for L ≥ 80m

L ship's length, in m, but need not be taken greater than 200 metres,
T draught, in m, at the highest subdivision load line,
$Z_G$ height of the centre of area of the door, in m, above the baseline.

**S9.4 Scantlings of side shell doors and stern doors**

S9.4.1 *General*

S9.4.1a The strength of side shell doors and stern doors is to be commensurate with that of the surrounding structure.

S9.4.1b Side shell doors and stern doors are to be adequately stiffened and means are to be provided to prevent any lateral or vertical movement of the doors when closed. Adequate strength is to be provided in the connections of the lifting/manoeuvring arms and hinges to the door structure and to the ship's structure.

S9.4.1c Where doors also serve as vehicle ramps, the design of the hinges should take into account the ship angle of trim and heel which may result in uneven loading on the hinges.

S9.4.1d Shell door openings are to have well-rounded corners and adequate compensation is to be arranged with web frames at sides and stringers or equivalent above and below.

**S9.4.2** ***Plating and secondary stiffeners***

S9.4.2a The thickness of the door plating is not to be less than the required thickness for the side shell plating, using the door stiffener spacing, but in no case less than the minimum required thickness of shell plating.

Where doors serve as vehicle ramps, the plating thickness is to be not less than required for vehicle decks.

S9.4.2b The section modulus of horizontal or vertical stiffeners is not to be less than that required for side framing. Consideration is to be given, where necessary, to differences in fixity between ship's frames and door stiffeners.

Where doors serve as vehicle ramps, the stiffener scantlings are not to be less than required for vehicle decks.

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**S9.4.3** ***Primary Structure***

S9.4.3a The secondary stiffeners are to be supported by primary members constituting the main stiffening of the door.

S9.4.3b The primary members and the hull structure in way are to have sufficient stiffness to ensure structural integrity of the boundary of the door.

S9.4.3c Scantlings of the primary members are generally to be supported by direct calculations in association with the design forces given in S9.3 and permissible stresses given in S9.2.1a.

**S9.5 Securing and Supporting of Doors**

S9.5.1 ***General***

S9.5.1a Side shell doors and stern doors are to be fitted with adequate means of securing and supporting so as to be commensurate with the strength and stiffness of the surrounding structure. The hull supporting structure in way of the doors is to be suitable for the same design loads and design stresses as the securing and supporting devices.

Where packing is required, the packing material is to be of a comparatively soft type, and the supporting forces are to be carried by the steel structure only. Other types of packing may be considered.

Maximum design clearance between securing and supporting devices is not generally to exceed 3mm.

A means is to be provided for mechanically fixing the door in the open position.

S9.5.1b Only the active supporting and securing devices having an effective stiffness in the relevant direction are to be included and considered to calculate the reaction forces acting on the devices. Small and/or flexible devices such as cleats intended to provide local compression of the packing material are not generally to be included in the calculations called for in S9.5.2b. The number of securing and supporting devices are generally to be the minimum practical whilst taking into account the requirement for redundant provision given in S9.5.2c and the available space for adequate support in the hull structure.

S9.5.2 ***Scantlings***

S9.5.2a Securing and supporting devices are to be adequately designed so that they can withstand the reaction forces within the permissible stresses given in S9.2.1a.

S9.5.2b The distribution of the reaction forces acting on the securing devices and supporting devices may require to be supported by direct calculations taking into account the flexibility of the hull structure and the actual position of the supports.

S9.5.2c The arrangement of securing devices and supporting devices in way of these securing devices is to be designed with redundancy so that in the event of failure of any single securing or supporting device the remaining devices are capable to withstand the reaction forces without exceeding by more than 20 per cent the permissible stresses as given in S9.2.1a.

S9.5.2d All load transmitting elements in the design load path, from the door through securing and supporting devices into the ship's structure, including welded connections, are to be to the same strength standard as required for the securing and supporting devices.

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**S9** cont'd

**S9.6 Securing and Locking Arrangement**

S9.6.1 ***Systems for operation***

S9.6.1a Securing devices are to be simple to operate and easily accessible.

Securing devices are to be equipped with mechanical locking arrangement (self locking or separate arrangement), or are to be of the gravity type. The opening and closing systems as well as securing and locking devices are to be interlocked in such a way that they can only operate in the proper sequence.

S9.6.1b Doors which are locateeed partly or totally below the freeboard deck with a clear opening area greater than $6m^2$ are to be provided with an arrangement for remote control, from a position above the freeboard deck, of :

. the closing and opening of the doors,
. associated securing and locking devices.

For doors which are required to be equipped with a remote control arrangement, indication of the open/closed position of the door and the securing and locking device is to be provided at the remote control stations. The operating panels for operation of doors are to be inaccessible to unauthorized persons. A notice plate, giving instructions to the effect that all securing devices are to be closed and locked before leaving harbour, is to be placed at each operating panel and is to be supplemented by warning indicator lights.

S9.6.1c Where hydraulic securing devices are applied, the system is to be mechanically lockable in closed position. This means that, in the event of loss of the hydraulic fluid, the securing devices remain locked.

The hydraulic system for securing and locking devices is to be isolated from other hydraulic circuits, when closed position.

S9.6.2 ***Systems for indication/monitoring***

S9.6.2a The following requirements apply to doors in the boundary of special category spaces or ro-ro spaces, as defined in the SOLAS Convention, through which such spaces may be flooded.
For cargo ships, where no part of the door is below the uppermost waterline and the area of the door opening is not greater than $6m^2$, then the requirements of this section need not be applied.

S9.6.2b Separate indicator lights and audible alarms are to be provided on the navigation bridge and on each operating panel to indicate that the doors are closed and that their securing and locking devices are properly positioned.

The indication panel is to be provided with a lamp test function. It shall not be possible to turn off the indicator light.

S9.6.2c The indicator system is to be designed on the fail safe principle and is to indicate by visual alarms if the door is not fully closed and not fully locked and by audible alarms if securing devices become open or locking devices become unsecured. The power supply for the indicator system is to be independent of the power supply for operating and closing the doors and is to be provided with a backup power supply.

The sensors of the indicator system are to be protected from water, ice formation and mechanical damages.

S9.6.2d The indication panel on the navigation bridge is to be equipped with a mode selection function "harbour/sea voyage", so arranged that audible alarm is given if the vessel leaves harbour with side shell or stern doors not closed or with any of the securing devices not in the correct position.

S9.6.2e For passenger ships, a water leakage detection system with audible alarm and television surveillance is to be arranged to provide an indication to the navigation bridge and to the engine control room of any leakage through the doors. ▶

**S9** cont'd

For cargo ships, a water leakage detection system with audible alarm is to be arranged to provide an indication to the navigation bridge.

**S9.7 Operating and Maintenance Manual**

S9.7.1 An Operating and Maintenance Manual for the side shell and stern doors is to be provided on board and contain necessary information on :

- main particulars and design drawings,
- service conditions, e.g. service restrictions, emergency operations, acceptable clearances for supports,
- maintenance and function testing,
- register of inspections and repairs.

This Manual has to be submitted for approval.

Note : It is recommended that recorded inspections of the door supporting and securing devices be carried out by the ship's staff at monthly intervals or following incidents that could result in damage, including heavy weather or contact in the region of side shell and stern doors. Any damage recorded during such inspections is to be reported to the Classification Society.

S9.7.2 Documented operating procedures for closing and securing side shell and stern doors are to be kept on board and posted at the appropriate places.

Explanatory Note

The external pressure applied on stern doors is derived from the formula considered in UR S8 for bow doors, assuming :

$\alpha$ = 0 degree
$\beta$ = 90 degrees
V = 2 knots

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# UR - S15 SIDE SHELL DOORS AND STERN DOORS

## RETROSPECTIVE APPLICATION OF UR-S9, AS AMENDED 1996,

## TO EXISTING RO-RO PASSENGER SHIPS

1. The structural condition of side shell doors and stern doors, especially the primary structure, the securing and supporting arrangements and the hull structure alongside and above the doors, are to be specially examined and any defects rectified.

2. The following measures are to be complied with by all existing Ro-Ro passenger ships no later than completion of the first annual survey commenced after 1 July 1997 :

a) The structural arrangement of securing devices and supporting devices of inwards opening doors in way of these securing devices and, where applicable, of the surrounding hull structure is to be re-assessed in accordance with the applicable requirements of S9.5 and modified accordingly.

b) The securing and locking arrangments for side shell doors and stern doors which may lead to the flooding of a special category space or ro-ro cargo space as defined in the SOLAS Convention, are to comply with the followings requirements :

- Separate indicator lights and audible alarms are to be provided on the navigation bridge and on each operating panel to indicate that the doors are closed and that their securing and locking devices are properly positioned.
  The indication panel is to be provided with a lamp test function. It shall not be possible to turn off the indicator light.

- The indication panel on the navigation bridge is to be equipped with a mode selection function "harbour/sea voyage", so arranged that audible alarm is given if the vessel leaves harbour with side shell or stern doors not closed or with any of the securing devices not in the correct position.

- A water leakage detection system with audible alarm and television surveillance is to be arranged to provide an indication to the navigation bridge and to the engine control room of any leakage through the doors.

3. Documented operating procedures for closing and securing side shell and stern doors are to be kept on board and posted at the appropriate places.

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